

Applicants : Isabel Gavela, et al.  
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Filed : Herewith  
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Attorney's Docket No.: 14219-116US1  
Client Ref. No.: P2004,0009 US N

**AMENDMENTS TO THE SPECIFICATION:**

Please delete the word "Description" at page 1, line 1.

Please add the following centered heading at page 1, line 5:

**TECHNICAL FIELD**

Please add the following centered heading at page 1, line 13:

**BACKGROUND**

Please add the following centered heading at page 3, line 11:

**SUMMARY**

Please add the following centered heading at page 9, line 19:

**DESCRIPTION OF THE DRAWINGS**

Please add the following centered heading at page 10, line 14:

**DETAILED DESCRIPTION**

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Please replace the Abstract on page 19 with the following new Abstract:

A duplexer that includes an input filter (Rx filter), an output filter (Tx filter), and one or more of an isolation line and a delay line is disclosed. The Rx and Tx filters are microwave (MW) resonators and include continuous, internally metallized holes in a ceramic body. The ceramic body includes a metal coating substantially covering the external surfaces of the ceramic body except for an end face and one or more recesses on a bottom side of the ceramic body. An output of the Rx filter on the bottom side of the ceramic body is electrically connected to a balun. The ceramic body has a first height in an area of the Tx filter and a second height in an area of the Rx filter, the second height being less than the first height.

Please delete the phrase "Duplexer with Low Overall Height" at page 19, line 3.

Please delete the phrase "Significant figure: 2" at page 19, line 12.

Please delete the phrase "Figure 1 – Stand der Technik = state of the art" at page 19, line 15.

Please replace the paragraph beginning at page 3, line 12 with the following amended paragraph:

~~The object of the present invention is therefore to provide a~~ A duplexer having a balun functionality which can be designed with the same base area in comparison with a duplexer without a balun and with a lower overall height is disclosed.

Please delete the paragraph beginning "This object is achieved according to" at page 3, line 16.

Please replace the paragraph beginning at page 3, line 19 with the following amended paragraph:

~~The present invention proposes~~ In some embodiments, a duplexer includes which ~~comprises, without any change,~~ an RX filter (input filter), a TX filter (output filter) and a line connected between the two filters, optionally an isolation line and/or a delay line or both. Both filters are designed in a shared ceramic body as microwave resonators in the form of continuous internally metallized holes. With some exceptions, e.g., an end face and recesses for the contacts on the bottom side, the ceramic body has a largely closed exterior metallization which is in electric contact with the metallized holes on the short-circuit end opposite the end face.

Please replace the paragraph beginning at page 4, line 12 with the following amended paragraph:

In some embodiments, the duplexer ~~The present invention~~ benefits from the advantageously low insertion loss of microwave ceramic filters which have a substantial safety margin from the specification limit even without a balun and with the original overall height. It is therefore possible to reduce the overall height of the RX filter, in which case the negative effect on insertion loss associated with this is still enough to fulfill the required specifications of the communication system. Since only the RX filter has a reduced overall height, the TX filter remains unchanged and has good insertion loss without any change.

Please replace the paragraph beginning at page 4, line 20 with the following amended paragraph:

The balun is implemented in an LTCC (low-temperature co-fired ceramic) and can therefore have an extremely small overall height of approximately 0.3 to 0.4 mm. For example, only five dielectric ceramic layers are sufficient to achieve this. Such a known balun (e.g., a Marchand balun having a coplanar design) can also be implemented with a base area smaller than the area required for the RX filter. Such a balun may be used according to ~~this invention~~ with a duplexer having a reduced overall height of 1.3 to 2.5 mm. In the area of the RX filter, the height of the ceramic body is then reduced by 0.3 to 0.4 mm, the amount required for the balun, to 0.9 to 2.2 mm.

Please replace the paragraph beginning at page 9, line 8 with the following amended paragraph:

In another embodiment, ~~an inventive~~ a duplexer may have a beveled edge at least on the edges of the end face toward the bottom side or it may drop off toward the bottom side in the form of an additional step. The capacitive terminal faces are then preferably designed to extend over this beveled edge or step. This ensures that the terminal faces have a better hold on the ceramic body and consequently the solder connections created on the terminal faces will also adhere tightly to the ceramic body.

Please replace the paragraph beginning at page 9, line 15 with the following amended paragraph:

The ~~present invention~~ duplexer is explained in greater detail below on the basis of exemplary embodiments and the respective figures. The figures show schematically various views of various embodiments of ~~inventive~~ duplexers. For a better understanding of ~~the present invention~~, they are not drawn true to scale. The same elements in different figures are labeled with the same reference numbers.

Please replace the paragraph beginning at page 9, line 23 with the following amended paragraph:

Figure 2 shows ~~an inventive~~ a duplexer from the front.

Please replace the paragraph beginning at page 10, line 1 with the following amended paragraph:

Figure 3 shows ~~a~~ an inventive a duplexer from underneath.

Please replace the paragraph beginning at page 11, line 15 with the following amended paragraph:

Figure 2 shows ~~a~~ an inventive duplexer in a view of the end face as seen from above. Here again, there is a shared ceramic body in which internally metallized holes RT for the resonators of the TX filter and holes RR for the resonators of the RX filter are implemented. In the area of the RX filter arranged at the left of the diagram, the height hR is reduced with respect to the height hT. This area forms a recess in which a balun BN is situated. This is implemented in an LTCC ceramic and has a overall height hB which advantageously corresponds to the depth of the recess. Therefore it holds that  $hT = hR + hB$ . The area of the recess is preferably designed so that it is suitable for completely holding the balun BN.

Please replace the paragraph beginning at page 12, line 11 with the following amended paragraph:

Figure 3 shows ~~a~~ an inventive duplexer from the bottom side and especially the position of the electric terminal faces of the duplexer provided there. The balun BN extends over the total length LR of the RX filter and is completely fitted into the recess.

In the embodiment depicted here, the outputs RX-OUTb of the balun, which at the same time form the RX outputs of the ~~inventive~~ component, are arranged close to or directly adjacent to the edge with the end face. The input TX-IN of the TX filter is likewise provided in proximity to or directly adjacent to and preferably around the edge with the side face. In this embodiment, the antenna terminal ANT is arranged in proximity or directly adjacent to the edge to the rear side of the duplexer opposite the end face of the duplexer. On the other surface of the balun BN is the surface of the bottom dielectric layer (in a normal view). It may be partially metallized – but isolated from the outputs RX-OUTb – to achieve a better electric and/or mechanical connection to the circuit board to which the duplexer is usually soldered. On the other bottom side of the ceramic body not covered by the balun, the exterior metallization of the duplexer is arranged, electrically isolated from the capacitive terminal faces TX-IN and ANT via the isolating areas IB.

Please replace the paragraph beginning at page 13, line 13 with the following amended paragraph:

Figure 5 shows another embodiment ~~of the present invention~~ with a balun BN having a smaller base area. It has a length LB which is shorter than the length LR of the RX filter. The balun is arranged directly adjacent to the end face. This results in the height hR of the ceramic body being equal to the original height in the area of the short-circuit end of the RX filter and equal to the height hT of the ceramic body in the area of

the TX filter:  $hT = hR$ . Such a duplexer having a smaller balun and/or with no change in height ( $hR = hT$ ) of the ceramic body on the side of the RX filter and on the short-circuit end of the filter has improved electric values for the RX filter in comparison with the exemplary embodiments according to Figures 3, 4 and 6.

Please replace the paragraph beginning at page 14, line 5 with the following amended paragraph:

Figure 7 shows a detail of ~~a~~ ~~an inventive~~ duplexer with another design in the area of the edges between the end face SF and the bottom side. The originally rectangular edge there is replaced by a beveled edge F, where the ceramic body is beveled at the edge. The capacitive terminal faces for the filter preferably extend from the bottom side of the ceramic body to beyond the beveled edge F. Figure 7 also shows another possible embodiment ~~of the present invention~~ in which the connecting face AF also extends beyond parts of the side face SEF. Accordingly, the isolating area IB extends to the side face while also electrically isolating the connecting face AF from the exterior metallization AM there.

Please replace the paragraph beginning at page 14, line 14 with the following amended paragraph:

Figure 8 shows another possible embodiment of the edge design of ~~an inventive~~ a duplexer. In the area of the edge between the side face SEF and the bottom side US, the ceramic body has a step S. All connecting faces AF, an exterior one of which is shown in

the figure, are preferably extended beyond the bottom side as well as beyond both step faces. This results in improved adhesion of the connecting face, which is further intensified for the connecting face AF depicted here by being continued onto parts of the side face SF.

Please replace the paragraph beginning at page 14, line 21 with the following amended paragraph:

A An inventive duplexer with a balun integrated into the outside dimensions of the ceramic body has an insertion loss of the RX path which is elevated in comparison with a duplexer without a balun but is still equal to or less than that of a comparable embodiment, e.g., with an FBAR filter or a SAW filter. The insertion loss of the TX path remains low on the whole, which is advantageous. In some embodiments, the duplexer This invention offers the possibility of arranging the symmetrical output RX-OUTs on the balun largely independently of the RX filter without this having any effects on the electric properties of the filter and thus the duplexer. The overall flat design of the duplexer, which is not elevated in comparison with that of a traditional duplexer without a balun, is also advantageous. This is a compact, one-piece and easily handled component. The balun at the output of the RX path permits a simple impedance adjustment of the asymmetrical output of the RX filter to the antenna. The outputs RX-OUTb of the balun may be adapted to a value deviating from 50 ohm. In addition, the adaptation of the RX-OUT of the duplexer and the RX-IN of the balun may be selected

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freely in a range that is favorable for both of the individual components and may be, for example, not equal to  $50 \Omega$ . The balun at the output of the RX path also maintains the good power compatibility of the duplexer of more than 33 dBm.